

New distances for a selected set of visual binaries with inconsistent dynamical masses

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ABSTRACT

We have selected a set of 17 visual binaries that demonstrate great inconsistency between the systemic mass obtained through Kepler’s Third Law as compared to that calculated through standard mass-luminosity and mass-spectrum relationships. A careful inspection of orbital data and parallaxes showed that the current orbits of nine binaries (WDS 00155–1608, WDS 00174+0853, WDS 05017+2050, WDS 06410+0954, WDS 16212–2536, WDS 17336–3706, WDS 19217–1557, WDS 20312+1116, and WDS 21118+5959) do not need to be improved, instead we recommend different parallax (distance) value for them. On the other hand, we considered that eight orbits (WDS 02366+1227, WDS 02434–6643, WDS 03244–1539, WDS 08507+1800, WDS 09128–6055, WDS 11532–1540, WDS 17375+2419, and WDS 22408–0333) had to be improved. Due to various reasons mentioned in this paper, their distances should most likely be corrected unless better orbital solutions and/or more precise parallaxes are reported. To obtain consistent mass values, the use of the dynamical parallax is still recommended for 5 out of the 8 improved orbits. For WDS 02434–6643, WDS 09128–6055, and WDS 11532–1540, the improvement itself yields reasonable mass sums while maintaining π_{Hip} within a 1-2 σ margin. New distance estimates for 16 stars (mainly based on the obtained dynamical parallaxes) and individual comments for all objects are presented and discussed.

Subject headings: Stars: binaries – distances, Stars: visual binaries – masses

1. Introduction

Visual binaries are a fundamental source of data on stellar masses as well as a key observational interface for theoretical stellar evolution models. The determination of accurate orbits in binary systems with well established parallaxes represents a direct and reliable method for obtaining the dynamical mass of stars through Kepler’s Third Law, thus providing a useful constraint on binary star formation and evolution mechanisms (Torres 2010, Mathieu 1994).

The direct application of Kepler’s Third Law

sometimes leads to an anomalous dynamical mass for various reasons such as poorly determined parallaxes and/or orbital elements, the existence of unknown companion(s), etc. The differential photometry of pairs whose combined brightness is usually well known allows us to estimate the luminosity and mass of individual components through empirical mass–luminosity (M–L) and mass–spectrum relationships (Gray 2005, Schmidt-Kaler 1982). Similarly, the accuracy of these relations is affected by various factors such as luminosity effects, magnitude difference, variability, etc. (See Table 1).

In the paper of Malkov et al. (2012), dynamical masses were reported for a selected sample of 652 visual binaries with essentially good quality orbital solutions, along with estimated masses of their individual components. For a pair with reasonably well-determined orbital elements, any large difference between these two sums could pos-

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sibly (but not only) indicate either an imprecise or even erroneous parallax. On the other hand, such inconsistent data represent a good starting point for a more detailed overview and further improvement of the actual orbital elements. Obviously, certain criteria should be applied in order to characterize the level of inconsistency and to select the final set of objects as well.

In Section 2, we describe the requirements for the binaries to be selected for further analysis. We also explain the effect of the trigonometric parallax on the observed inconsistency between dynamical and photometric masses. Comments on particular systems along with brief presentations of their improved orbits and masses are given in Section 3. The obtained results are summarized in Section 4.

2. The sample selection criteria

A careful inspection of dynamical masses for 652 binaries reported by Malkov et al. (2012) with updated orbital data (as of September 2015) was carried out. When possible, the dynamical mass, M_d , was first compared with the photometric mass, M_{ph} , estimated from the observed photometry, the trigonometric parallax, and the M-L relation and, secondly, with the spectral mass, M_{sp} estimated from the spectral classification and the mass-spectrum relation.

In most cases, only combined spectral types were available, and spectral type of the secondary was unknown. We assigned individual spectral types following the method described by Edwards (1976) applying magnitude differences taken from the Fourth Catalog of Interferometric Measurements of Binary Stars (Hartkopf et al. 2001a, hereinafter INT4). Apart from this, in our analysis we have made extensive use of dynamical mass, M_{BR} , derived according to the Baize & Romani method (Baize & Romani 1946; Heintz 1978) and the corresponding dynamical parallax, π_d (using updated M-L calibrations).

For photometric mass estimation, we used the M-L relation from Malkov (2007) for the upper-MS, Henry & McCarthy (1993) for the lower-MS, and Henry et al. (1999) for the lowest masses. Subgiants and early-type (O–F6) giants were considered to be 1 mag brighter than dwarfs (Halbwachs 1986). Lastly, for the few remaining late-giant and supergiant stars, photometric masses

were estimated using Tables II and VI of Straizys & Kuriliene (1981). Pairs with unknown luminosity class were considered to be MS-systems. The luminosity class of the secondary component, when unknown, was considered to be the same as for the primary. If the magnitude of the secondary component was unknown, equal brightness of components was assumed, and, consequently, an upper limit for photometric mass was estimated. Spectral masses were estimated using Table VI of Straizys & Kuriliene (1981). If the spectral type of the secondary was unknown, the listed spectral mass is the primary mass (i.e., it represents a minimum mass of the system). The main sequence is assumed if the luminosity class was unknown, as it was done in Malkov et al. (2012), which seems to be a reasonable assumption for our relatively nearby orbital binaries.

In some cases, a relatively large discrepancy between the above mentioned masses was found. The most obvious reasons for such discrepancies are imprecise parallaxes and/or orbital elements as well as the presence of a third undetected body (or subcomponents) that lead to the M_d overestimation (Tamazian et al. 2006) and a “ M_{ph} excess” for a given luminosity (see, e.g., Kroupa et al., 1991; Malkov et al., 1997). Among other reasons that explain the discrepancy between dynamical and photometric masses, one should mention incorrect spectral classification, interstellar extinction underestimation, and variability of the components. Individual photometric masses also depend on stellar evolution and chemical abundance variations (Bonfils et al. 2005). Finally, outdated cataloged data and cross-identification errors can also distort mass values. The main reasons that would lead to inconsistent dynamical mass values are listed in Table 1 and all pairs with inconsistent masses require further study of their astrophysical properties and dynamics, as well.

The accuracy of the dynamical mass calculated through Kepler’s Third Law, M_d , mainly depends on the quality of the orbital parameters and the parallax determination. The usual accuracy of an MS star’s photometric mass, M_{ph} , is about 15%. Therefore, for a binary star, we assume it to be $\approx 20\%$. Out of the main sequence, the accuracy is 2-3 times lower and we assume it to be $\approx 60\%$. As for spectral mass, M_{sp} , the accuracy is lower than 20% and we assume 30% accuracy for a binary.

TABLE 1
INFLUENCE OF VARIOUS PARAMETERS AND STELLAR CHARACTERISTICS ON THE
VALUE OF DYNAMICAL, PHOTOMETRIC, AND SPECTRAL MASSES.

Parameter/reason	M_d	M_{ph}	M_{sp}
Spectral (temperature) class	no	no	yes
Luminosity class	no	yes	yes
Interstellar extinction	no	yes	no
Trigonometric parallax	yes	yes	no
Semi-major axis, period	yes	no	no
Magnitude difference	no	yes	no
Variability	no	yes	(yes/no) ^a
Unresolved binarity	yes	yes	no
Third (undetected) component	yes	no	no
Anomalous metallicity	no	yes	no
Pre-MS stage	no	yes	no

^a Depends on variability type

For the systems where spectral classification is provided only for the primary component and the magnitude difference is unknown, M_{sp} should be considered as a lower limit. In only one case (WDS 06410+0954), we found $M_{sp} > M_{ph}$. Other cases with obvious disagreement (the difference between various mass estimates exceeds double accuracy) were also considered. Additionally, systems with unrealistic, high ($M_d > 50M_\odot$) and low ($M_d < 0.2M_\odot$) dynamical masses were included.

The parallaxes are mainly taken from original (Perryman et al. 1997) and revised (van Leeuwen 2007) reductions of the *Hipparcos* mission data.

Hipparcos parallaxes are subject to effects of stellar duplicity. The companion was taken into account in calculating parallax, when the pair is sufficiently wide to produce separate measurements for the two components. At least in some cases the presence of a companion increases the formal errors (see van Leeuwen 2007 for discussion and examples). It should be added that *Hipparcos* can provide unreliable solutions for orbital periods close to one year, and very long orbital periods can produce too insignificant non-linear motions of the photocentre over the short (3-year) measurement duration.

The expected M_{ph} fits within the error bars of M_{Dyn} for 431 out of the 652 systems that comprise

our sample (66%). This number slightly increases to 451 (69%) if the original *Hipparcos* parallaxes are applied but it is mainly due to their lower accuracy. If we consider both sets of the *Hipparcos* data ignoring errors, the corresponding numbers become nearly identical (320 and 327 pairs when applying reprocessed and original data, respectively) along with an obviously expected decrease in percentage (50%). Thus, when checking the consistency between dynamical and photometric masses in this large sample of visual binaries, we have found no significant difference when applying either original or reprocessed *Hipparcos* data.

It is worth noting that M_{dyn} tends to be larger than M_{ph} for systems with a larger error in the parallax, and $M_{dyn} > M_{ph}$ in 342 cases (52.4%) for our entire sample. If we apply the $\sigma_\pi < 20\%$ condition, the sample is reduced to 176 objects and $M_{dyn} > M_{ph}$ for 84 of them (47.7%). This means that we generally underestimate stellar luminosity and, hence, M_{ph} for systems with a larger error in the parallax (see discussion in Francis, 2014).

All of the selected systems are listed in Table 2. The columns refer to: (1) the Washington Double Star Catalog (Mason et al. 2001, hereinafter WDS) designation; (2) the *Hipparcos* identification; (3-4) the magnitudes and (5) the spectral types of components; (6-7) the reprocessed *Hip-*

TABLE 2
VISUAL BINARIES WITH INCONSISTENT DYNAMICAL MASS AND SUGGESTED PARALLAXES

WDS	HIP	m ₁	m ₂	Sp1+Sp2	π_{Hip} (mas)	$\sigma_{\pi_{Hip}}$ (mas)	M_d (M_{\odot})	σ_{M_d} (M_{\odot})	M_{ph} (M_{\odot})	M_{sp} (M_{\odot})	G	R	$\pi_{sugg.}$ (mas)	M_{BR} (M_{\odot})
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00155–1608	1242	11.0	11.4	M3.5V+M5V	200.53	9.41	0.17	0.02	0.39	0.50	2	dp	166.81 ^a	0.29
00174+0853	1392	7.78	8.38	F7V+G0V	65.85	18.31	0.02	0.02	1.48	2.18	2	d	15.31 ^a	1.48
02366+1227**	12153	5.68	5.78	F7V+F7V	28.79	0.43	19.1	2.57	2.95	2.26	1 ₂	dp, ds	21.23 ^b	3.36
02434–6643**	12717	6.83	7.23	F4V+F7V	18.40	0.43	14.6	4.04	2.67	2.38	3	dp, ds	19.26 ^c	2.63
03244–1539**	15868	8.40	8.40	G1V+G1V	20.27	0.73	0.62	0.11	2.1	2.0	3 ₄	dp	28.89 ^b	1.64
05017+2050	23396	8.45	9.32	G0V+G5V	26.17	1.08	0.15	0.04	1.78	2.00	3	dp, ds, d	10.15 ^b	2.55
06410+0954*	31978	4.66	5.90	O7Ve+O9V	3.55	2.77	3.58	1.59	17.3	62.9	4	ps	1.39 ^a	59.1
08507+1800**	43421	7.66	7.57	G5V+G5V	2.77	1.03	372.6	461.5	7.8	1.90	3	ps	34.37 ^b	1.80
09128–6055**	45214	6.97	7.27	B9V+B9V	5.77	0.48	34.1	12.5	5.4	5.1	3	dp, ds	5.82 ^c	5.22
11532–1540**	57955	8.61	9.29	A9V+F1V	3.74	1.05	59.3	59.2	4.1	3.0	3	d	5.77 ^c	3.07
16212–2536*	80112	3.30	4.10	B1III+B1III	4.68	0.60	56.7	22.0	15.6	34.0	8	d	5.76 ^a	30.3
17336–3706	85927	2.08	2.73	B1.5IV+B2IV	5.71	0.75	77.5	30.6	22.6	21.9	2	d	8.93 ^a	18.5
17375+2419**	86254	5.90	7.30	A1Vn+A8V	13.04	0.31	13.8	1.34	3.71	3.9	3	dp, ds	18.40 ^b	3.06
19217–1557*	95176	4.58	–	F2p+F2	1.83	0.23	10.6	7.4	32.1	2.70	8	ps	1.83 ^a	20.0
20312+1116	101233	7.90	8.00	Am+Am	16.67	10.67	0.20	0.38	2.46	–	3	d	7.43 ^b	3.93
21118+5959	104642	6.50	7.10	B0II+B0II	0.76	0.42	202.1	352.2	27.3	50.2	3	d	1.18 ^a	20.1
22408–0333**	111465	6.52	8.63	F6V+G9V	28.93	0.77	0.80	0.22	2.16	1.92	2 ₃	dp	18.84 ^b	2.32

NOTE.—* spectroscopic binary; ** newly calculated orbit; subscript in column 12 indicates the orbit's previous grade

^asee comments in the text

^b π_d

^c π_d within 1-2 σ of π_{Hip}

parcos parallax (van Leeuwen, 2007) and its uncertainty; (8-9) the dynamical mass and its uncertainty; (10) the photometric mass; (11) the spectral mass (all masses are given in units of solar mass); (12) the orbit quality grade (G) according to the scheme described in the Sixth Catalog of Orbits of Visual Binary Stars (Hartkopf et al. 2001b; hereinafter ORB6) where Grade 1 corresponds to a definitive orbit and Grade 5 is assigned to an indeterminate orbit. For some improved orbits, the subscript indicates their previous grade; (13) the reason or reasons, R, why the system is included in Table 2. Among the reasons are the following: a large difference between dynamical and photometric (dp), between dynamical and spectral (ds) and between photometric and spectral (ps) masses, as well as a dynamical mass that is too high or too low (d). The last two columns, 14 and 15, list the suggested (mostly dynamical) parallax and the corresponding systemic mass, respectively. Spectroscopic binaries are marked in Column 1 with an asterisk and pairs with newly calculated orbits (Docobo et al. 2015) are marked with a double asterisk.

3. Individual systems

In this section, we discuss individual binaries listed in Table 2.

WDS 00155–1608 (=HIP 1242). The application of the reprocessed *Hipparcos* parallax (200.53 ± 9.41 mas) to the orbit of Hershey & Taff (1998) with $a=0''.3037$ and $P=4.566$ yr gives $M_d=0.17$ (hereinafter, all masses are given in units of solar mass), which is too low for a pair of M3.5+M5 dwarfs. An astrometric study of these authors using HST FGS measurements (last measurement dated 1997.964) allowed them to obtain a trigonometric parallax of 166.6 ± 0.8 mas and a reasonable mass sum of 0.29 ($0.18+0.11$). Several high-quality astrometric measurements of this pair after 1997 were conducted (Docobo et al., 2006; Tokovinin et al. 2015), and improved orbits were calculated (Perez et al. 2015; Tokovinin et al. 2015). However, the semiaxis ($0''.3060$) and the period (4.550 yr) of the latest solution given by Tokovinin et al. (2015) are very similar to those reported by Hershey & Taff (1998), thus having small impact on the calculated total mass $M_d=0.30$ (instead of previous 0.29). Therefore, the application of the parallax corresponding to a distance of 6.00 pc (instead of 4.99 pc) seems to be more reasonable. Notice that this value lies within a 2σ margin of the original *Hipparcos* parallax, 191.86 ± 17.24 mas (Perryman et al. 1997).

WDS 00174+0853 (=HIP 1392). The current orbit for this pair ($P=35.7$ yr, $a=0''.19$) has been reported by Hartkopf & Mason (2010). The use of the original *Hipparcos* parallax (15.31 ± 1.35 mas; Perryman et al. 1997) instead of that reprocessed by van Leeuwen's (2007) value of 65.85 ± 18.31 mas readily converts the Malkov et al. (2012) unrealistic dynamical mass of 0.02 to a reasonable $M_d = 1.5 \pm 0.4$ for this pair of F7+G0 dwarfs.

WDS 02366+1227 (=HIP 12153). The first, almost circular ($e=0.037$) orbit of Balega & Balega (1988) with a period of 3.87 yr and semi-major axis of $a=0''.077$ led to $M_d=3.8$ (assuming $\pi_{Hip}=28.8$ mas) which is large for a couple of F7 dwarfs. The solution of Mason (1997) represents a highly elliptical orbit ($e=0.88$) with a two-fold shorter period of 1.92 yr and a slightly larger semi-major axis, $a=0''.119$, leading to an unrealistic $M_d=19.1$ while root mean squares (RMS) of (O-C) residuals both in ρ and θ are lower for this solution. We have calculated an improved orbit (Docobo et al. 2015; $P=3.80$ yr, $a=0''.077$, $e=0.017$) which gives the lowest RMS value and a reasonable mass of $M_{BR}=3.4$ ($\pi_d=21.23$ mas).

WDS 02434-6643 (=HIP 12717). Since a reliable magnitude difference, $dm=0.4$ mag, has been reported from speckle measurements (INT4 Catalog), we did not apply $dm=1.7$ mag that appears in the ORB6 Catalog. Using the combined magnitude, 6.26 mag, taken from SIMBAD, we adopted 6.83 mag and 7.23 mag for the apparent brightness of the components. From the improved orbit (Docobo et al. 2015), we obtained $\pi_d=19.26$ mas and $M_{BR}=2.6$ that are compatible with F4+F7 dwarfs. Notice that $\pi_{Hip}=18.40 \pm 0.43$ mas.

WDS 03244-1539 (=HIP 15868). Previous orbits of Muller (1955) and Starikova (1978) have similar periods of about 25 yr, $a=0''.15$, and $e=0.19$ leading to $\pi_d \approx 12.6$ mas ($\pi_{Hip}=20.27 \pm 0.73$ mas) and $M_d \approx 0.6$ which is inconsistent for a couple of early G dwarfs. A new, rather elliptical orbit by Docobo et al. (2015) with a shorter period of 11.35 yr, a larger semi-major axis ($a=0''.17$), and $e=0.51$, significantly improves the global RMS values. Although its $\pi_d=28.89$ mas does not coincide well with that of *Hipparcos*, we obtained a reasonable dynamical mass, M_{BR} ,

of about 1.6 and recommend this π_d as a distance estimate.

WDS 05017+2050 (=HIP 23396). The current orbit (Hartkopf & Mason 2010) is of good quality (Grade 3) and leads to $\pi_d=10.15$ mas ($M_{BR}=2.55$), which is far from the $\pi_{Hip}=26.17 \pm 1.08$. We suggest the use of π_d as an estimate for its distance.

WDS 06410+0954 (=HIP 31978). These are the recently resolved subcomponents: Aa, Ab of CHR 168 (pre-main sequence variable star, S Mon = 15 Mon). The dynamical mass, 3.58, given in Malkov et al. (2012) is unrealistic for a couple of O7+O9.5 dwarfs. The reason for this is the application of an erroneous *Hipparcos* parallax of 3.58 mas (282 pc) This value clearly differs from that used by Gies et al. (1997), 950 pc, as well as from the more probable value of 720 pc suggested by Cvetkovic et al. (2010). Both solutions lead to a similar dynamical mass (60) that is compatible with the spectral type. The orbit by Cvetkovic et al. (2010) has a significantly larger period ($P=74.3$ yr) and a semi-major axis ($a=0''.096$) that is larger than the earlier Gies' et al. (1997) solution ($P=23.6$ yr, $a=0''.034$). The RMS of residuals are smaller for the Cvetkovic et al. (2010) and we recommend the use of a distance of 720 pc.

WDS 08507+1800 (=HIP 43421). The *Hipparcos* parallax, 2.77 ± 1.03 mas, is clearly erroneous because it leads to an unrealistic dynamical mass of 372 and an absolute magnitude of -0.3 mag for a G5V type star. The previous orbit (Hartkopf & Mason, 2000) with $P=116.7$ yr and $a=0''.48$ gave a $\pi_d=13.82$ mas (72.4 pc) and a global mass of 3.0 which is large for a pair of G5 dwarfs. We obtained a new orbit (Docobo et al. 2015) with a similar period but larger semi-major axis ($P=113.4$ yr, $a=0''.98$) providing $\pi_d=34.37$ mas (29.1 pc) and reasonable values for both $M_{BR}=1.8$ and the absolute magnitude of the main component (+5.5). Therefore, 29.1 pc is a realistic distance estimate for this star.

WDS 09128-6055 (=HIP 45214). Previous orbits by Mason & Hartkopf (2011) and Heintz (1996) reported periods of 78.5 yr ($a=0''.343$) and 71.3 yr ($a=0''.265$), respectively, as well as dynamical masses of 34 and 19 which are too large for a pair of late B dwarfs. A new orbit (Docobo

et al. 2015) with a significantly larger period of $P=400$ yr and $a=0''.55$ leads to $\pi_d=5.82$ mas and $M_{BR}=5.2$ which is quite reasonable for this pair.

WDS 11532–1540 (=HIP 57955). The orbit by Hartkopf & Mason (2010) with $P=145.3$ yr, $a=0''.403$, and $e=0.287$ yields $M_{BR}=2.4$ but its $\pi_d=10.87$ mas is then rather different from $\pi_{Hip}=3.74\pm1.05$ mas. Docobo et al. (2015) reported an almost two-fold larger period ($P=236$ yr), rather elliptical ($e=0.703$) solution with a slightly smaller semi-major axis ($a=0''.321$) that gives $M_{BR}=3.1$ which is more reasonable for a pair of A9+F1 stars. Notice that its $\pi_d=5.77$ mas lies within a 2σ margin of π_{Hip} .

WDS 16212–2536 (=HIP 80112). This binary composed of two B giant stars belongs to the multiple system, σ Sco. Its combined visual-spectroscopic orbit yields an orbital parallax of 5.76 ± 0.68 mas (North et al. 2007). This value exceeds that of *Hipparcos* (4.68 ± 0.60 mas) but it produces more reasonable masses of the components: 18.4 ± 5.4 and 11.9 ± 3.1 . Tkachenko et al. (2014) calculated the masses to be 14.7 ± 4.5 and 9.5 ± 2.9 that corresponds to an even greater parallax, 6.23 mas.

WDS 17336–3706 (=HIP 85927). Tango et al. (2006) combined interferometric and spectroscopic data for this pair and showed that it consists of B1.5IV and B2IV stars located at $\pi_d=8.93\pm0.4$ mas which is approximately 1.5 times larger than $\pi_{Hip}=5.71\pm0.75$ mas.

WDS 17375+2419 (=HIP 86254). There are two possible solutions for this system: (i) a short-period, rather eccentric orbit ($P_1=10.42$ yr, $0''.127$, $e=0.75$) and (ii) a long-period, almost circular orbit ($P_2=20.92$, $0''.096$, $e=0.03$) leading to $\pi_d=18.34$ mas and 7.63 mas, respectively. The M_{BR} obtained in the first solution (3.1) looks more realistic for a pair of A1+A8 dwarfs than the second one (4.7), and its π_d is closer to π_{Hip} (13.04 ± 0.31 mas).

WDS 19217–1557 (=HIP 95176). This massive, single-lined spectroscopic binary contains a bright star and an unseen companion. In their medium spectral resolution interferometric observations, Bonneau et al. (2011) found WDS 19217–1557 ($=\nu$ Sgr) to be an interactive binary with a non-conservative evolution. The B5-A0

supergiant status (rather than F2p, given in SIMBAD) indicates M_{sp} to be about 10 and makes the Malkov et al. (2012) M_{sp} estimations (1.35) incorrect. As the hotter, unseen secondary component seems to be more massive (Bonneau et al. 2011), the minimum total mass of the system should be at least ≈ 20 which is more consistent with the Malkov et al. (2012), $M_{ph}=32.1$. Yet, Bonneau et al. (2011) mention that the separation of the stars may have been much smaller than estimated. This hypothesis would imply that the distance to the system is greatly underestimated. If so, $M_d=10.6\pm7.4$ (Malkov et al. 2012) should be increased.

WDS 20312+1116 (=HIP 101233). Tetzlaff et al. (2011) in their catalog of young runaway *Hipparcos* stars give 1.5 ± 0.1 for the mass of the primary which is consistent with our $M_{ph}=2.46$ (Malkov et al. 2012). The unrealistic M_d value (0.2) obtained by Malkov et al. (2012) can be explained by either incorrect orbital elements (the quality of the orbit is rather low) or an overestimated parallax: van Leeuwen (2007) provided $\pi=16.67\pm10.67$ mas used in Malkov et al. (2012) while the original *Hipparcos* value is $\pi=-3.06\pm9.53$ mas (Perryman et al. 1997). The current orbit of Hartkopf & Mason (2014) leads to $\pi_d=7.43$ mas.

WDS 21118+5959 (=HIP 104642). According to the WDS discoverer designation, this system is McA 67Aa, Ab. Its current orbital elements, $P=56.93$ yr and $a=0''.066$ reported by Zirm & Rica (2012), along with a very poorly determined $\pi_{Hip}=0.76\pm0.42$ mas led to an unrealistic mass of $M_d=202.1$. However, applying the upper 1σ limit for π_{Hip} (1.18 mas), we obtained a rather reasonable $M_d=54$ for a couple of B0 giants. Notice that Stone (1978) computed a distance of 400 pc ($\pi=2.5$ mas) using the spectral type and “intrinsic color – absolute magnitude – spectral type” calibrations, but it led to an unacceptably small $M_d=5.7$ with a current orbit of Grade 3. A much more precise parallax for this star is needed.

WDS 22408–0333 (=HIP 111965). A new orbital solution (Docobo et al. 2015; $P=54$ yr) improved the previous orbit of Soderhjelm (1999) and agreed well with that of Griffin & Heintz (1987) in radial velocity data. We suggest using $\pi_d=18.84$ mas ($M_{BR}=2.3$) instead of

$\pi_{Hip}=28.93\pm0.77$ mas.

4. Conclusions

Of 652 visual binaries with essentially good quality orbits, a set of 17 pairs with largely inconsistent (with standard mass-luminosity and mass-spectrum calibrations) dynamical masses was selected. The main results of this study can be summarized as follows:

- On the basis of a careful overview of orbital and astrophysical data, new distance estimates (differing from those of *Hipparcos*) that restore the observed dynamical mass consistency for 16 stars are suggested.

- We found no significant difference between original and reprocessed *Hipparcos* data applications when detecting dynamical mass inconsistency.

- Recent orbital solutions for 8 binaries are briefly discussed. Three of them led us to reasonable dynamical masses while remaining within the 1-2 σ margin of the *Hipparcos* parallax.

- Inconsistency of different mass estimates should be considered as an indicator for imprecise parallax and/or orbital elements of the binary system.

- M_{ph} is generally underestimated, especially for systems with large parallax error.

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